

REMARKS

In accordance with the foregoing, the specification has been amended and claims 1 and 2 have been amended to clarify features of the invention and, further, new claims 31-35 have been added.

No new matter is presented and, accordingly, approval and entry of the foregoing amended and new claims are respectfully requested.

STATUS OF CLAIMS

Claims 1, 2, 6, 8-14, 29 and 30 are pending herein.

Claims 1 and 2 are rejected whereas all of the remaining claims are now allowed.

ITEM 2: REJECTION OF CLAIM 1 FOR ANTICIPATION UNDER 35 USC § 102(e) BY HIGASHI ET AL.

The rejection is respectfully traversed.

Claim 1 stands rejected under 35 USC §102(e) as being anticipated by Higashi et al(USP 5,918,113) in item 2 of the outstanding Office Action. This is the identical rejection of claim 1 as was made in item 3 of the first Office Action (in which claim 7 was also so rejected but which was canceled in the intervening response). Applicants incorporate herein by reference the response to the rejection in item 3 of the first Office Action in support of the traverse of the current rejection.

Higashi et al utilizes an anisotropic conductive adhesive film 20, which the Examiner cites as an underfill material sheet 20. The adhesive film 20 of Higashi et al contains conductive particles 22 dispersed therein, as stated in column 3, lines 49-54 of Higashi et al. The conductive particles 22 of Higashi et al serve to establish an electric connection between a conductive ball 32 and a pad 12, as shown in Fig. 1.

Claim 1 is amended in the foregoing to specify that the underfill material sheet is "made of an insulating, non-conductive material." (Emphasis added)

Higashi et al. does not teach the use of an insulating, non-conductive material as an underfill material sheet, as defined in the currently amended claim 1. Accordingly, the rejection

based on the disclosure of Higashi et al. should be withdrawn.

ITEM 3: REJECTION OF CLAIMS 1 AND 2 FOR ANTICIPATION UNDER 35 USC § 102(e) BY MACHIDA ET AL.

Claim 1 additionally stands rejected, as does claim 2, under 35 USC § 102(e) as being anticipated by Machida et al. (*USP 5,972,780*) in the outstanding Office Action. The rejection is respectfully traversed.

This is the identical rejection as was made in item 3 of the first Office Action. Applicants accordingly incorporate by reference herein the traverse of the rejection set forth in the intervening response. The rejection is further traversed on the following grounds.

Particularly, the Examiner further states in item 4 of the Action, spanning pages 3-4, that applicants rely on a feature not recited in the rejected claims and, specifically, "using the conductive bumps to connect a chip and a printed circuit board...." (Action at page 4, lines 1-2)

Accordingly, applicants have introduced the recitation "said conductive bump being designed to be received on a printed circuit board" in the currently amended claim 1.

The rejection based on the disclosure of Machida et al. thus should be withdrawn.

Claim 2 also stands rejected under 35 USC § 102(e) as being anticipated by Machida et al. in the outstanding Office Action.

However, applicants submit that Machida et al. completely fails to disclose or even suggest the recitation of claim 2, of "softening the underfill material sheet" and "hardening the underfill material sheet." Since the thin film material is peeled off after the underfill material sheet is hardened, the thin film material is smoothly removed from the underfill material. This concept is not disclosed or even suggested in Machida et al.

The rejection based on the disclosure of Machida et al. thus should be withdrawn.

DEPENDENT CLAIMS 31 AND 34

The new dependent claims 31/1 and 34/2 define the material of the *underfill* material sheet. The mixture of a thermosetting adhesive and a thermoplastic resin may be utilized as an underfill material in the invention defined in claims 1 and 2. This is not disclosed or even suggested in any of the prior art references.

Claims 31 and 34, respectively dependent from the independent claims 1 and 2, thus further patentably distinguish over the references of record and are respectfully submitted to be allowable for this additional, common reason in addition to inheriting the patentable distinctions of their respective independent claims 1 and 2.

DEPENDENT CLAIMS 32 AND 35

The new dependent claims 32/1 and 35/2 define the height of the conductive bump, as being equal to or larger than the thickness of the underfill material sheet and which is submitted to further patentably distinguish over the references of record.

If the conductive bump is smaller than the thickness of the underfill material sheet, the conductive bump may be embedded within the underfill material. Moreover, the underfill material tends to get interposed between the conductive bump and a pad receiving the conductive bump when a semiconductor chip is mounted on a printed circuit board. The interposed underfill material may hinder the establishment of an electric connection between the semiconductor chip and the printed circuit board. This is not desirable. The feature recited in claims 32 and 35 avoids that problem and thus affords a clear advantage and improvement which is not disclosed by, or even suggested in, any of the prior art references.

Accordingly, at least claims 32 and 35, dependent from the independent claims 1 and 2, patentably distinguish over the references of record and should be allowed, for this further reason as well as for the basic allowability of independent claims 1 and 2 from which they respectively depend.

ITEM 4: EXAMINER'S RESPONSE

PARAGRAPH 1 REGARDING HIGASHI ET AL.

The first paragraph of the Examiner's response in item 4 addresses the applicants' arguments of the prior response:

(1)...[T]hat the adhesive film 20 in Higashi et al. is only transferred to substrate 60 and not to wafer 50 and

(2) that the adhesive layer 20 in Higashi et al. is not an underfill material sheet

to which the Examiner responds:

- (1)' Higashi et al. clearly teaches transferring the adhesive film 20 to the wafer 50 (see Fig. 12a); and
- (2)' ...[T]he adhesive layer 20 is an underfill material sheet (see col. 3, lines 45-65)

The Examiner's point (1)', is contrary to the discussion of Figs. 11 and 12a, 12b at col. 7, line 15 through 30 of Higashi et al., at which the structure of Fig. 11 is described as being achieved by

[A]dhering the isotropic conductive adhesive film 20 onto the wafer-mounting substrate 60 provided with electrode terminal contacts 12a, and bonding the semiconductor wafer 50 thereon.

(Emphasis added)

Hence, there is no reference disclosure or suggestion in Higashi et al. of using a thin film member for transferring the underfill material 20 onto the wafer 50. To the contrary, Higashi et al. teach in relation to the Fig. 11 structure that the adhesive film 20 is transferred onto the wafer mounting substrate 60 and thereafter the semiconductor wafer 50 is bonded onto the film 20 to achieve the Fig. 11 structure.

Addressing point (2)', the Higashi et al. reference teaches that the underfiller of prior art practices is a "drawback in that the production efficiency is inferior because it requires the underfiller-filling process and the curing process." (Col. 1, lines 28-39; emphasis added) Thus, Higashi et al. is a "teaching-away" from the underfiller process of the present invention.

Further, the discussion of Fig. 2, similarly to Fig. 11, expressly teaches that the adhesive film 20 is first adhered to the circuit board 10 by releasing the release paper 24 and thereafter a semiconductor chip 30 is bonded to the adhesive film by releasing the release paper 26. (Col. 3, line 65 - col. 4, line 18)

Figs. 3a through 3d and col. 4, line 46 through col. 5, line 10 likewise illustrate this same sequence and, again, emphasize that the Higashi et al. process makes it "possible to eliminate an underfilling step...." (Col. 5, lines 3-5)

Figs. 12a and 12b are discussed at col. 7, lines 23 et seq. and initially are presented as being "contrary..."--presumably, to Fig. 11. However, while Fig. 11 seemingly is being discussed

in col. 7, lines 15-22, that description does not recite the reference numerals used in Fig. 11. Instead, Fig. 11 uses reference numerals more similar to those appearing in Fig. 3(e), for example. In any event, Fig. 11, if subject to the description at col. 7, lines 15-23, again teaches adhering the adhesive film 20 on a substrate and then bonding a semiconductor wafer onto the film 20.

Fig. 12 presumably is intended disclose a reverse sequence, relative to Fig. 11, of laminating the film 20 onto the semiconductor wafer 50 (see Fig. 12(a)) and then bonding the same to the substrate 60. However, Higashi again emphasizes that the adhesive layer is "preliminarily provided in a semiconductor chip-mounting area of each of circuit boards, which is then softened and pressed by a semiconductor chip to suitably bond the same with the circuit board. Thus, it is possible to eliminate the underfilling step...." (Col. 7, lines 45-51)

Accordingly, Higashi et al. clearly is a "teaching-away" from the present invention.

PARAGRAPH 2 REGARDING MACHIDA ET AL.

The Examiner, in the case of Machida et al.--as in the case of Higashi et al.--characterizes the dielectric film 20 as an "underfill" material--even though the term "underfill" is never employed in Machida et al.

As has been shown above, Machida et al. is not relevant to underfill techniques and is equally irrelevant to the present, claimed invention as is Higashi et al.

CONCLUSION

In accordance with the foregoing, it is submitted that the claims as now pending herein distinguish patentably over the references and, there being no other objections or rejections, that the application is in condition for allowance, which action is earnestly solicited.

Serial No. 09/753,570

If there are any additional fees associated with filing of this Amendment, please charge the same to our Deposit Account No. 19-3935.

Respectfully submitted,

STAAS & HALSEY LLP

Date: July 22, 2003

By: 

H.J. Staas

Registration No. 22,010

1201 New York Avenue, NW, Suite 700
Washington, D.C. 20005
Telephone: (202) 434-1500
Facsimile: (202) 434-1501